DOCUMENT RESUME

ED 209 094 SE 035 806

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TITLE Differences in Mathematics Achievement Between Males and Females in Grades 1-3.
PUB DATE Mar 81
NOTE 19p.; Paper presented at the Annual Meeting of the Eastern Educational Research Association (Philadelphia, PA, March 14, 1981).

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Academic Achievement; Achievement Rating; Basic Skills; *Cognitive Development; *Disadvantaged Youth; Educational Research; *Elementary School Mathematics; Females; Learning Theories; Longitudinal Studies; Males; *Mathematics Achievement; Mathematics Instruction; Primary Education; *Sex Differences
IDENTIFIERS *Mathematics Education Research

ABSTRACT

This investigation was undertaken to compare males and females on their performance on standardized mathematics achievement tests during primary grades. The achievement of more than 3,000 children in grades one through three was measured in the five school districts in which the University of Georgia Follow-Through Program was implemented. The 1978 Metropolitan Achievement Test (MAT), Form JS, Survey Battery was administered to all Follow-Through pupils on a Fall (pre-test) and Spring (post-test) basis for the 1978-79 and 1979-80 school years. The results of the analyses of the mathematics achievement data indicated several possibilities which seem to warrant further research. Among the hypothetical postulates generated: (1) During grades one and two, females from disadvantaged populations scored higher than males in numerical operations and concepts as reflected in standardized tests; (2) Summer loss in mathematics achievement may be attributed to environmental factors in the disadvantaged children's communities; and (3) Understanding of mathematical operations and concepts is a function of cognitive development in young children. (MP)

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DIFFERENCES IN MATHEMATICS ACHIEVEMENT BETWEEN MALES AND FEMALES IN GRADES 1-3

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March 14, 1981

SE 035 806

DIFFERENCES IN MATHEMATICS ACHIEVEMENT BETWEEN MALES AND FEMALES IN GRADES 1-3

The difference between males and females in their performance on mathematics achievement during primary grades is an open question. Limited research would seem to indicate no sex differences in mastery of mathematical skills and concepts during the early school years. Maccoby and Jacklin (1974) report there are some studies that show females in disadvantaged populations perform better than males in early grades but the evidence is limited to very few studies. There is consistent evidence that males begin to move ahead of females during adolescence. However, even within this evidence the amount of superior performance varies greatly.

It has been suggested by some investigators that male superiority in mathematics during high school and college is part of a genetically based phenomenon. Others hold that higher mathematics performance by males is related to environmental factors. Literature describing this controversy is in abundance currently but the question has not been resolved.

This investigation was undertaken to compare males and females on their performance on standardized mathematics achievement tests because it remains an open question.

Description of the Program

The University of Georgia Follow Through Program is a comprehensive education project designed to meet the needs of educationally and economically deprived children in grades 1-3. It was nationally validated in February, 1981, by the Joint Dissemination Review Panel of the U.S. Department of Education as an exemplary model for teaching mathematics to young children.

This validation was made for all five school districts in which this model is being implemented. This review involved 115 classrooms and more than 3,000 children in grades 1-3.

The program is a Piagetian-based Early Childhood Education Model which has been formulated by the University of Georgia's Mathemagenic Activities Program (MAP). The fundamental goal of the program is to utilize instructional strategies and procedures which create a learning environment which facilitates cognitive growth and the acquisition of basic academic skills. It does not present a new mathematics curriculum. Instead, it outlines a method and a philosophy of teaching which follow Piaget's views of fundamental logico-mathematical relations and basic principles from his analyses of the knowledge acquisition process. The MAP model stresses particular modes of instruction which are closely matched to the children's stages of psychological development.

Piaget (1977) has stated, "It is a very general psychological law that the child can do something in action long before he becomes 'aware' of what is involved." Young children learn mathematics by becoming actively engaged in constructing mathematics for themselves. In MAP classrooms many physical materials are used to stimulate children to develop mathematical ideas and facts. Mathemagenic activities include manipulation of objects toward a constructive purpose. Specific learning tasks further the development of intelligence only when learners are actively engaged both mentally and behaviorally with the environment. They become engaged in exploratory activities which encourage them to assimilate new information relevant to a particular concept of desired learning. MAP is not unique in this mode of instruction. Other programs emphasize "learning by doing" and individual initiative in the classroom.

The MAP model is quite different from most other programs in that it

is also based on the principle of equilibration as the central factor in structural changes necessary to either stage or concept learning. Equilibration is the process of self-regulation in the assimilative and accommodative processes that compensates for mismatches and makes possible the development of more complex hierarchically operational structures. Mismatch occurs when children assimilate new information into existing mental structures. As cognitive structures change to accommodate this new information, equilibrium is restored.

The component of self-regulation requires the teacher to provide a variety of appropriate activities from which children can make choices. Independent activity is viewed as necessary to learning. By providing opportunities for self-regulation the teacher is able to diagnose appropriate mismatches and create conditions which are conducive to learning. A certain amount of autonomy is implied by the term "self-regulation." While many lessons are highly structured and others involve teachers or aides as guides, children should be provided opportunities to select from a variety of appropriate activities and to work without direct adult supervision during some part of every day. This variety of appropriate activities in the MAP classroom is drawn from a series of appropriate mismatches designed to expose children to an environment that is congruent with their individual operational structures.

Young children approach mathematics in three stages: preoperational, transitional, and concrete operational. The developmental levels of learners are assessed by teachers in a MAP classroom. These stages not only describe important ways by which children develop but they are particularly important to consider when mathematics instruction is being planned. MAP teachers are trained to design instruction that provides appropriate mismatches between what children know and new information that is to be encountered. Continual

mismatches are created which build upon children's previous knowledge and skills.

Methodology and Procedures

Mathematics achievement of more than 3,000 children in grades 1-3 has been measured in the five school districts in which the University of Georgia Follow Through Program is implemented. These five school districts are located in Gulfport, Mississippi; Lee County, Virginia; McCormick County, South Carolina; Pickens County, Georgia; and Pocatello, Idaho. The majority of the children have been identified as economically deprived. In addition to being located in different geographical areas, these children may be described with different ethnic and cultural backgrounds.

The 1978 Metropolitan Achievement Test (MAT), Form JS, Survey Battery was administered to all Follow Through children on a Fall (pre-test) and Spring (post-test) basis for the 1978-1979 and 1979-1980 school years. Test administration occurred during the national norming dates recommended by the publisher to assure valid comparisons with national norms. The MAT was selected as a test of mathematics achievement for the following reasons:

1. The MAT is a basic academic skills inventory which tests for content having broad curriculum relevance and developed through input from over 3,000 classroom teachers.
2. The MAT was nationally normed during the Fall and the Spring.
3. K-R 20 reliability estimates for the MAT mathematics tests used (primer, Primary I and Primary II levels) are considered sufficient for the analyses undertaken. The publisher's reported reliabilities range from .86 to .89.
4. The MAT has a comprehensive and complete administration manual for use by classroom teachers and is written in language they can understand.

5. The MAT was specifically designed so as to avoid ethnic and sex bias in item content. A panel of minority teachers had sufficient input into test development.

6. The structuring of the Fall and Spring norming populations adequately reflected important demographic variables, e.g., ethnic populations, school size, geographic location.

The MAT mathematics tests were packaged and prepared for administration by University of Georgia Follow Through personnel. Instruments were coded with classroom rosters and distributed to teachers for administration. All teachers were provided with inservice training to review test administration rules and procedures. Tests were administered during the Fall and Spring of both testing years at the same time in the grade levels tested. All testings utilized hand scoreable booklets rather than computer scoring sheets. Test booklets were collected from teachers by local Follow Through personnel and submitted to the University of Georgia for processing and analysis. Test security was maintained in that no tests were kept by local school personnel.

The reliability and objectivity of MAT data was assured by the following set of procedures used by sponsor staff in scoring and processing: (1) All test booklets were hand coded. (2) Coded booklets were checked for correctness a second time. (3) All booklets were keypunched and verified. (4) A "check-scoring" computer program was used to examine MAT data punched on cards to identify any illegal values. (5) Any illegal values identified were corrected and assessed with the checking program a second time. Analyses of the MAT data were undertaken by University of Georgia Follow Through personnel.

MAT mathematics achievement data were avilable for two cohorts of Follow Through children for the 1978-1979 and 1979-1980 school years. These

data were analyzed using the norm-referenced model (Model A) designed for evaluations lacking a no-treatment comparison group. This model has been used extensively in the evaluation of Title I and other projects. As described by Tallmadge and Wood (1976), Linn (1978) and the United States HEW Department (Weinberger and Trotter, 1976), the model is useful for ascertaining whether academic achievement gains demonstrated over time exceeded those predicted using initial test performance indices.

Pre- and post-test MAT mathematics scores for two cohorts for two years were analyzed within the norm-referenced model using t-tests. All t-tests were computed using MAT Scaled Scores. For illustrative purposes, mean scaled scores have been translated to national percentiles.

Results

The results of the analyses of these mathematics achievement data are shown in Tables 1-4. Cohort I was in the second grade during 1978-1979 and in the third grade during 1979-1980. Cohort II was in the first grade during 1978-1979 and in the second grade during 1979-1980.

Table 1 shows the results of the 1978-1979 MAT mathematics achievement analyses for both cohorts by sex during Fall and Spring test administrations. These data indicate that females at the second grade level scored higher in mathematics achievement tests than males. There was no difference between males and females at the first grade.

Table 2 shows no difference between males and females in either cohort. The higher scores for females of Cohort I at the second grade level in 1978-1979 was not maintained at the third grade level in 1979-1980.

Tables 3 and 4 compare gain in mathematics achievement from Fall to Spring for males and females. They show no differences between gains for males and gains for females during either of the two years.

TABLE 1

Summary of Fall, 1978, and Spring, 1979, Metropolitan Achievement Test Scale Scores Results in Mathematics for Grades 1 and 2 in Five School Districts

	Fall											
	Males				Females							
Grade	$\bar{X}$	S.D.	%[1]	n	$\bar{X}$	S.D.	%[1]	n	$\bar{X}_D$	t	d.f.	p
1	333.54	85.81	38	369	337.36	76.34	40	306	- 3.82	-0.61	673	.55
2	440.12	72.49	38	354	455.34	79.03	47	319	-15.22	-2.61	671	.009*

	Spring											
	Males				Females							
Grade	$\bar{X}$	S.D.	%[1]	n	$\bar{X}$	S.D.	%[1]	n	$\bar{X}_D$	t	d.f.	p
1	454.79	80.42	68	369	453.26	77.92	68	306	1.53	.25	673	.80
2	509.62	82.30	52	354	526.31	83.87	61	319	-16.69	-2.60	671	.009*

*$p < .05$

[1]National Percentile Rank

TABLE 2

Summary of Fall, 1979, and Spring, 1980, Metropolitan Achievement Test Scale Scores Results in Mathematics for Grades 2 and 3 in Five School Districts

	Fall											
	Males				Females							
Grade	$\bar{X}$	S.D.	%[1]	n	$\bar{X}$	S.D.	%[1]	n	$\bar{X}_D$	t	d.f.	p
2	449.01	70.13	43	324	457.12	68.82	48	272	- 8.11	-1.42	594	.16
3	490.31	73.86	29	324	500.31	75.09	34	301	-10.0	-1.68	623	.09
	Spring											
	Males				Females							
Grade	$\bar{X}$	S.D.	%[1]	n	$\bar{X}$	S.D.	%[1]	n	$\bar{X}_D$	t	d.f.	p
2	534.03	77.75	65	324	535.13	79.07	65	272	- 1.1	.17	594	.87
3	585.83	86.89	59	324	598.50	86.68	64	301	-12.67	-1.82	623	.07

[1]National Percentile Rank

TABLE 3

Fall, 1978 to Spring, 1979, Metropolitan Achievement Test Scale Score Gains in Mathematics for Grades 1 and 2 in Five School Districts

	Males (n = 369)			Females (n = 306)						
Grade	$\bar{X}$	S.D.	%[1]	$\bar{X}$	S.D.	%[1]	$\bar{X}_D$	t	d.f.	p
1	121.25	69.59	30	115.90	66.16	28	5.35	1.02	673	.31

	Males (n = 354)			Females (n = 319)						
Grade	$\bar{X}$	S.D.	%[1]	$\bar{X}$	S.D.	%[1]	$\bar{X}_D$	t	d.f.	p
2	69.50	61.96	14	70.97	65.77	14	-1.47	- .30	671	.77

[1]National Percentile Rank

TABLE 4

Fall, 1979 to Spring, 1980, Metropolitan Achievement Test Scale Score Gains in Mathematics for Grades 2 and 3 in Five School Districts

	Males (n = 324)			Females (n = 272)						
Grade	$\bar{X}$	S.D.	%[1]	$\bar{X}$	S.D.	%[1]	$\bar{X}_D$	t	d.f.	p
2	85.02	69.17	22	78.01	69.96	17	7.01	1.23	594	.22

	Males (n = 324)			Females (n = 301)						
Grade	$\bar{X}$	S.D.	%[1]	$\bar{X}$	S.D.	%[1]	$\bar{X}_D$	t	d.f.	p
3	95.52	69.78	30	98.19	63.30	30	-2.67	- .50	623	.618

[1]National Percentile Rank

Discussion

The results showed that females entering the second grade in Fall, 1978, scored higher than males in mathematics achievement on the MAT. This difference in scores for all school districts combined was statistically significant ($p < .01$). In each of the school districts it was also a trend that females scored higher than males. This finding supports Maccoby and Jacklin (1974) who reported there appeared to be no sex differences in mastery of numerical operations and concepts during early grades, except in disadvantaged communities where females performed better than males.

In Spring, 1979, these differences were maintained between males and females. Gains in scores on mathematics achievement between fall and spring were approximately the same.

During the next school year, 1979-1980, these same males and females continued to make gains in comparison with the national norm and there were no longer significant differences between the scores of males and females. This pattern of growth suggests that the MAP model as a systematic program of mathematics instruction is equally effective for males and females in early grades when a standardized mathematics test is used as a measure of effectiveness.

Maccoby and Jacklin reported that males gradually gained on females during elementary grades in terms of munerical operations and concepts when these children were from disadvantaged populations. Data in this investigation are inconclusive in their support here. It can only be noted that females in Cohort I do not maintain their advantage over males throughout both school years. Gains in scores for both males and females are approximately the same for the second and third grades.

Data for Cohort II show that there is no difference between males and females at any testing time during the first or second grade. The pattern

of growth in Cohort II also suggests that the MAP model is equally effective for males and females when scores on a standardized mathematics test are used as the criterion for effectiveness.

An explanation for the apparent superiority of females over males in Cohort I which was not replicated in Cohort II during the second grade is not clear. There is a substantial summer loss for both cohorts in 1979. Scores which are recorded in Spring, 1979, are not maintained over the summer to Fall, 1979. The affects of this summer loss on males and females was not controlled in this investigation.

Different levels of cognitive development for males and females in Cohorts I and II were not determined and could account for different performances between males and females in Cohorts I and II. This hypothesis is postulated as a factor that could account for sex differences noted here in mathematics achievement test scores.

Future research seems warranted to check these hypothetical postulates:

1. During grades 1 or 2, females from disadvantaged populations will score higher than males in numerical operations and concepts as reflected in a standardized mathematics test.
2. Summer loss in mathematics achievement among children from disadvantaged populations may be attributed to environmental factors in their communities.
3. Understanding of mathematical operations and concepts is a function of cognitive development in young children.

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